Figure 1. Map showing the chance of minor damaging earthquake shaking in 100 years from the 2018 NSHM. The shaking is equivalent to Modified Mercalli Intensity VI and is based on the average 1 second horizontal spectral response acceleration and peak ground acceleration for NEHRP site class D (V_{S30} = 260 m/s).
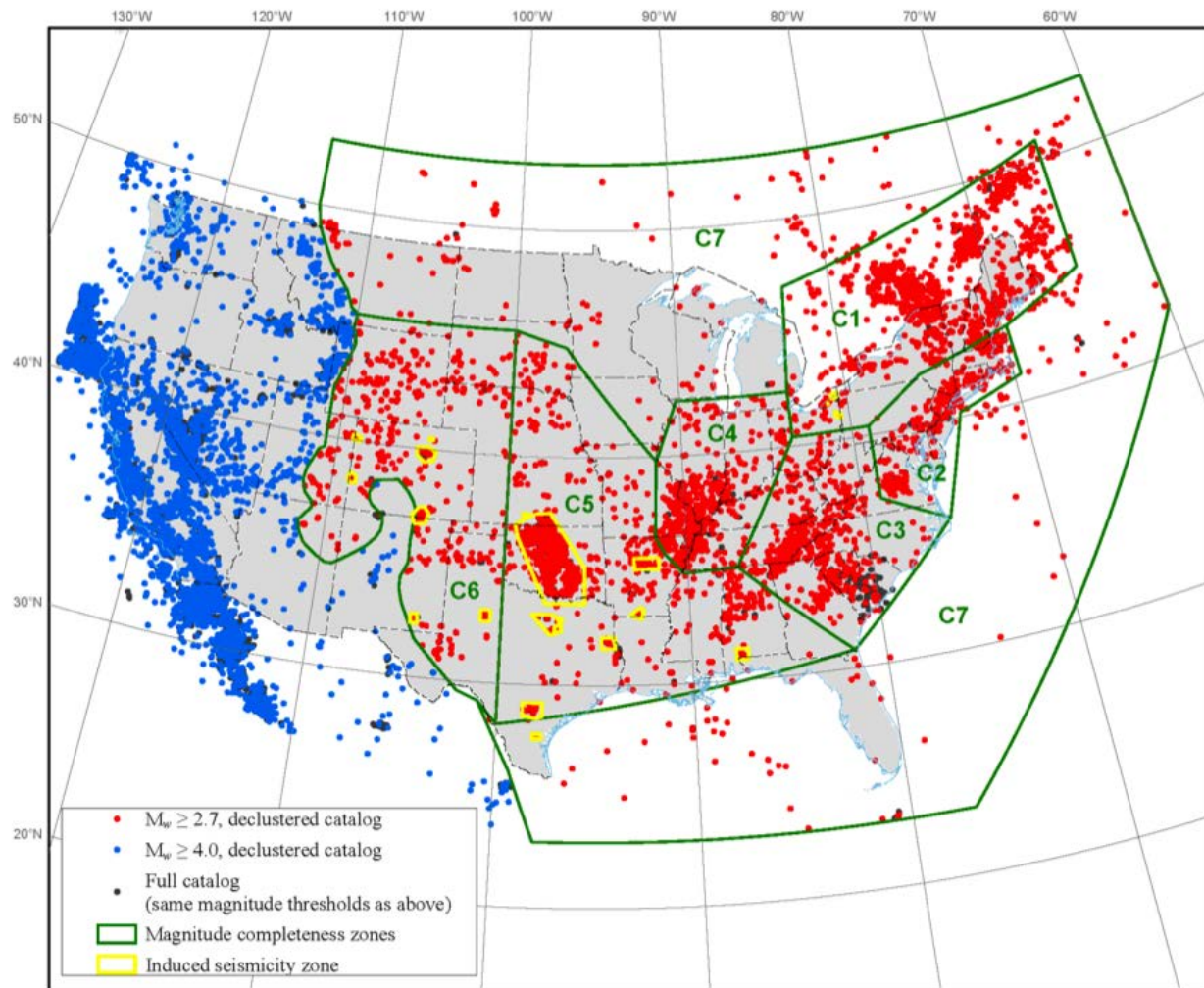
Figure 2. 2018 NSHM declustered seismicity catalogs: ($M_w \geq 2.7$) for the central and eastern U.S. (red) and ($M_w \geq 4.0$) for the western U.S. (blue). The full catalogs for each region are shown in black. New magnitude completeness zones shown as green polygons.
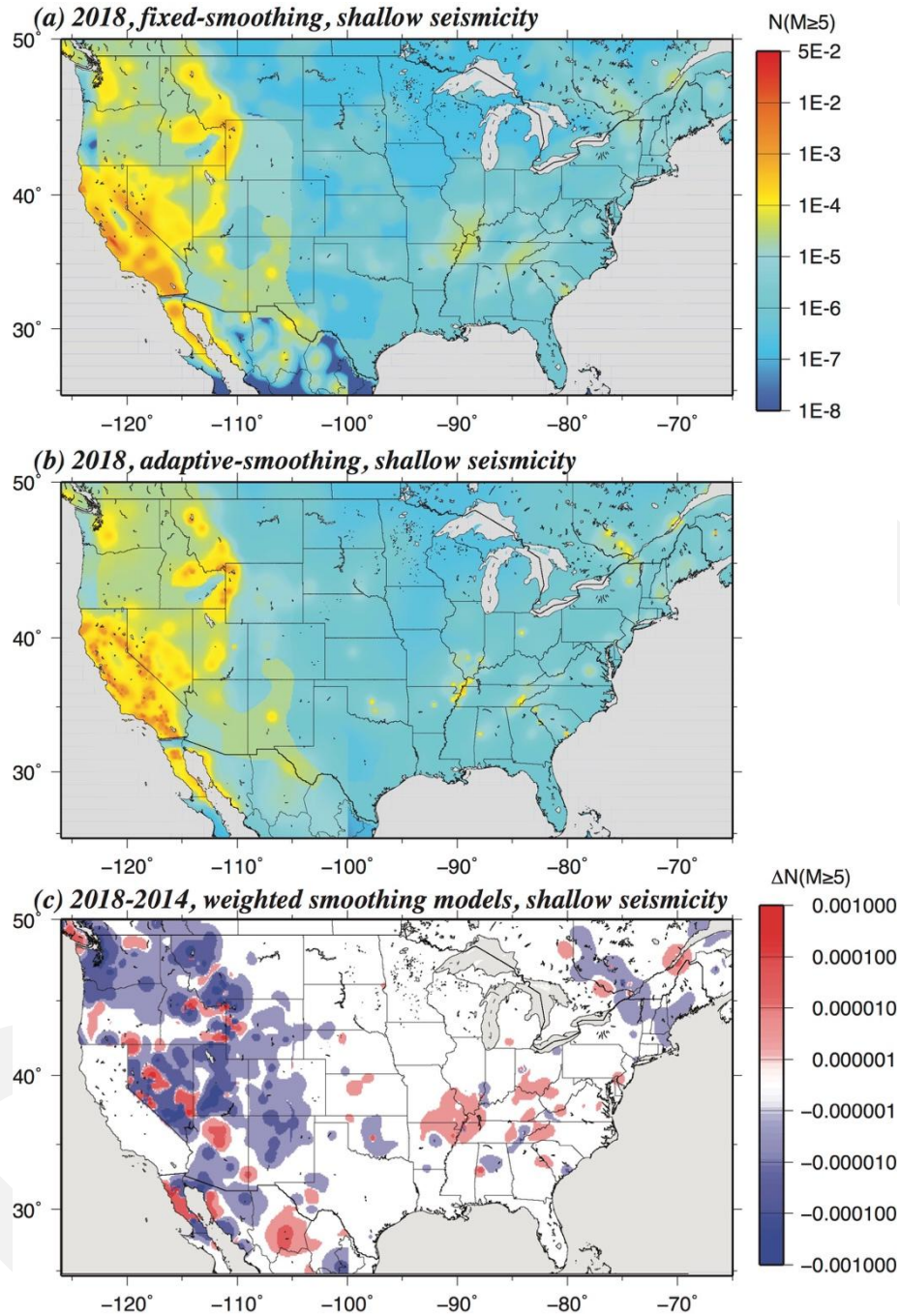
Figure 3. Maps depicting the annual rates of $M \geq 5$ earthquakes and the effect of updating the earthquake catalog between the 2014 NSHM and 2018 NSHM. All maps depict seismicity-based earthquake rates for shallow earthquakes. Earthquake rates from (A) fixed- and (B) adaptive-smoothed seismicity models for the conterminous U.S. (C) The effect of updating the seismicity catalog, 2014 to 2018, on the mean, weighted seismicity rates is depicted.
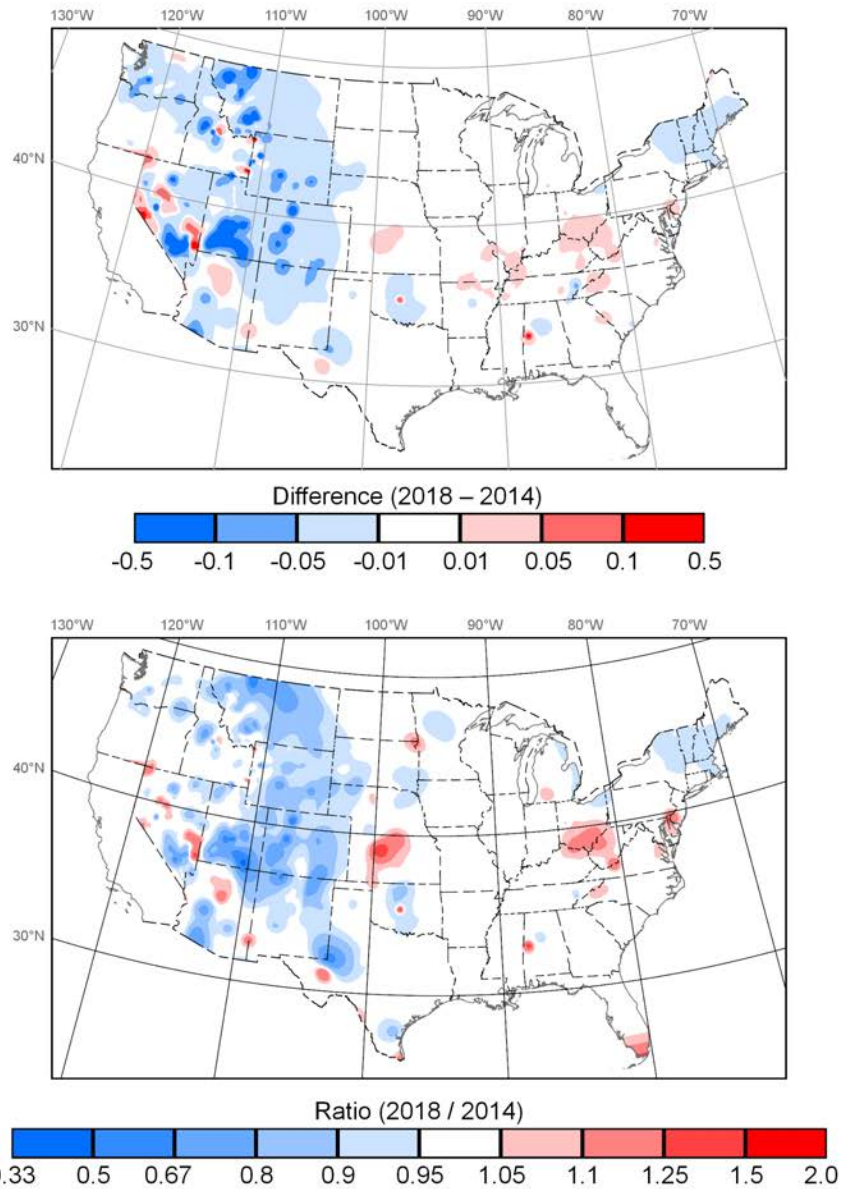
Figure 4. (A) Difference and (B) ratio maps showing comparisons between total mean hazard from the 2018 NSHM using the 2018 NSHM seismicity catalog and the 2014 NSHM catalog for the conterminous U.S. Maps are for 0.2 second spectral acceleration, 2% in 50 year probability of exceedance, and NEHRP site class boundary B/C (V_{S30} = 760 m/s).
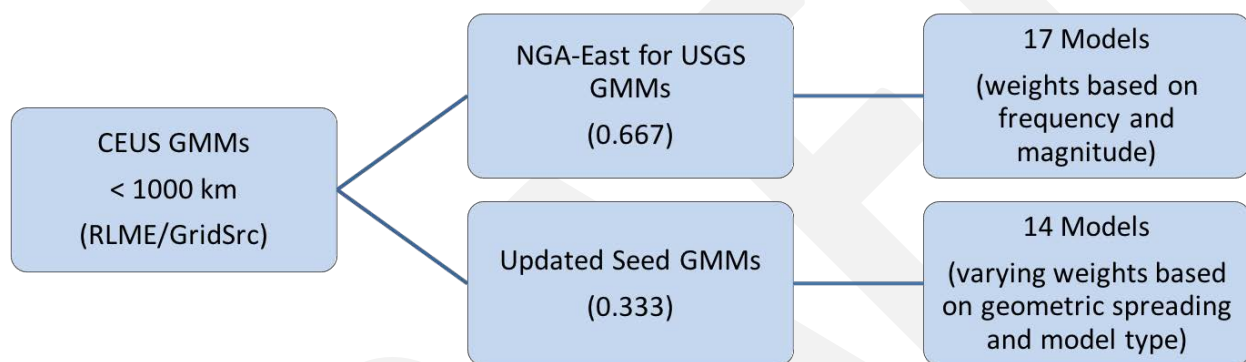
Figure 5. Logic tree for the central and eastern U.S. (CEUS) ground motion models (GMMs) in the 2018 NSHM update.
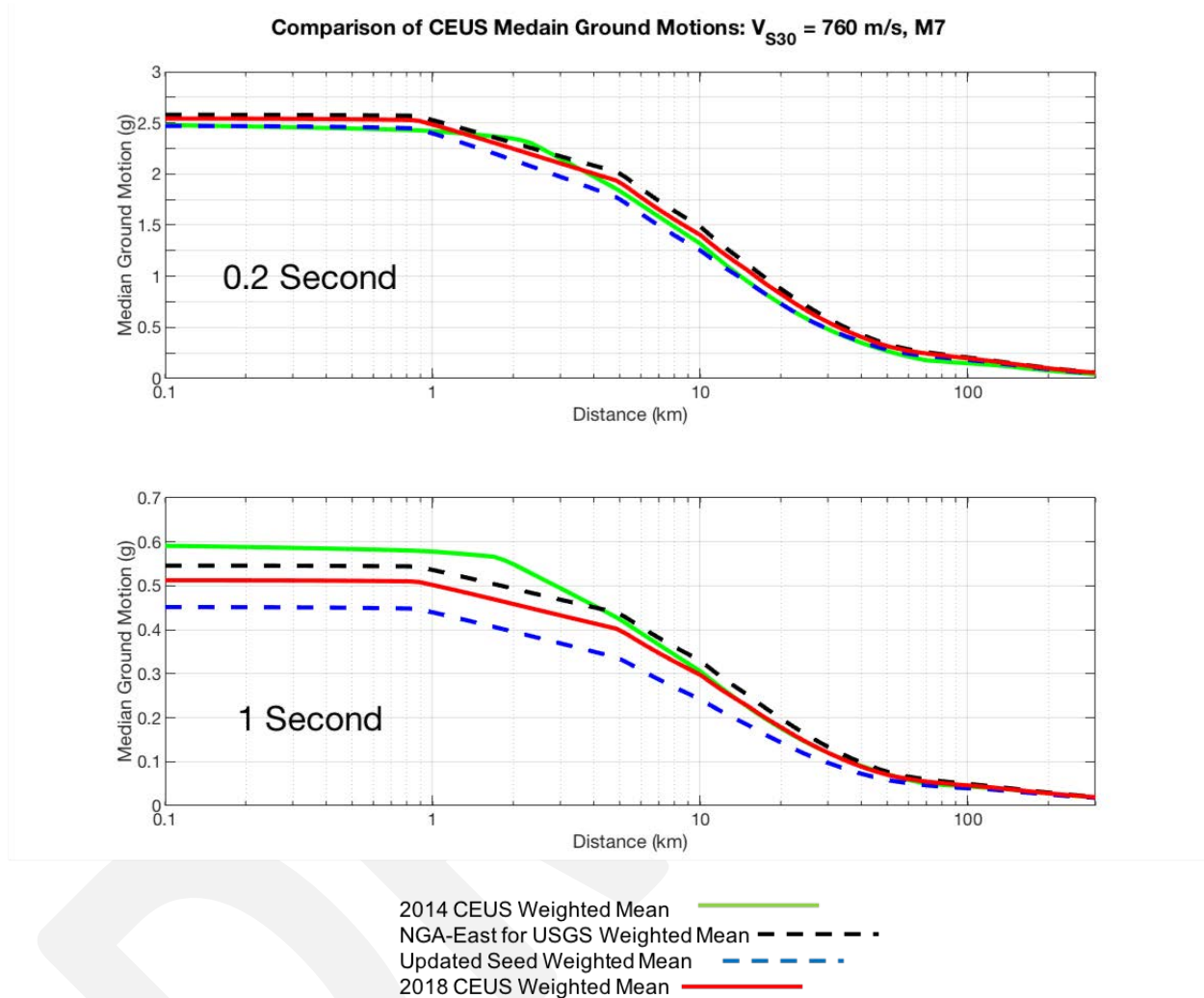
Figure 6. Ground motion vs. distance plots showing a comparison of central and eastern U.S. ground motion models (M = 7, V_{S30} = 760 m/s) for (A) 0.2 second spectral acceleration and (B) 1 second spectral acceleration.
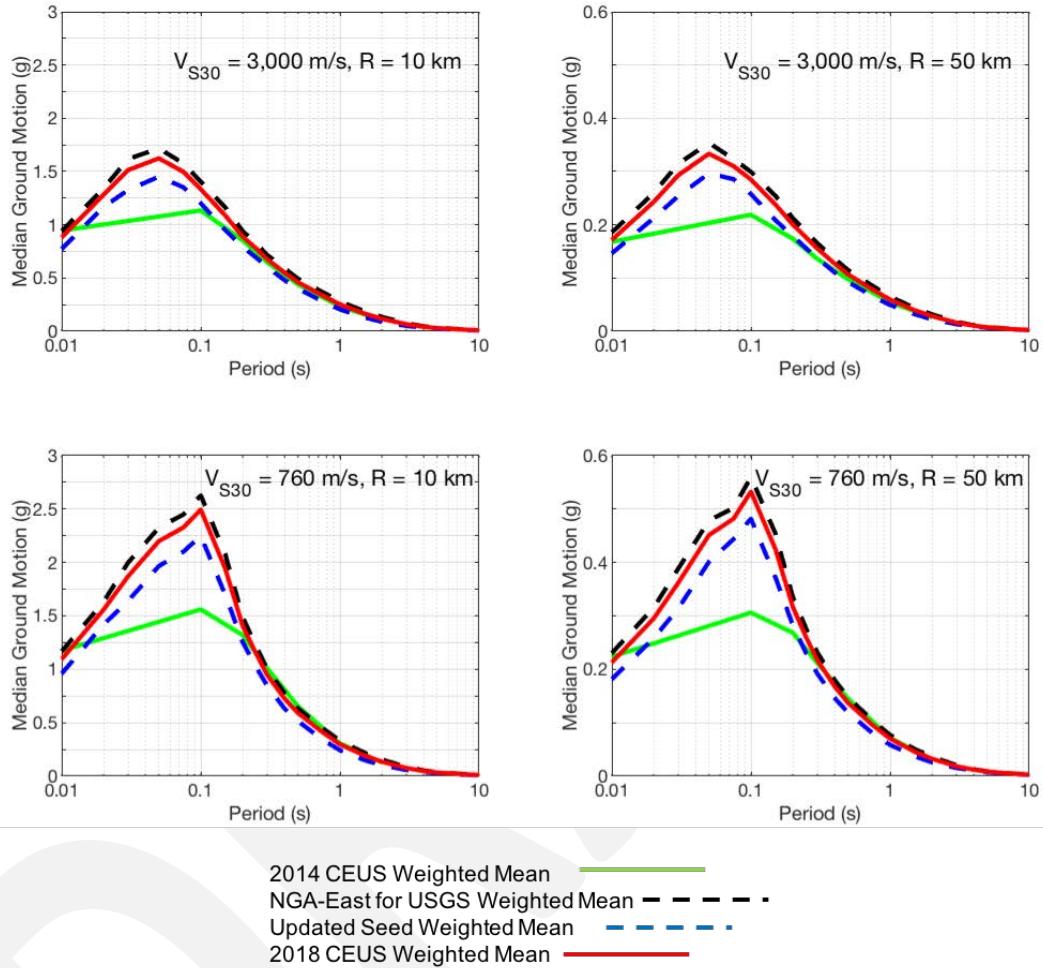
Figure 7. Ground motion vs. period plots showing a comparison of central and eastern U.S. ground motion models (M = 7) for (upper left) V_{S30} = 3,000 m/s, R = 10 km, (upper right) V_{S30} = 3,000 m/s, R = 50 km, (lower left) V_{S30} = 760 m/s, R = 10 km, and (lower right) V_{S30} = 760 m/s, R = 50 km. Note that the 2014 NSHM ground motions were not calculated between peak ground acceleration and 0.1 second spectral acceleration.
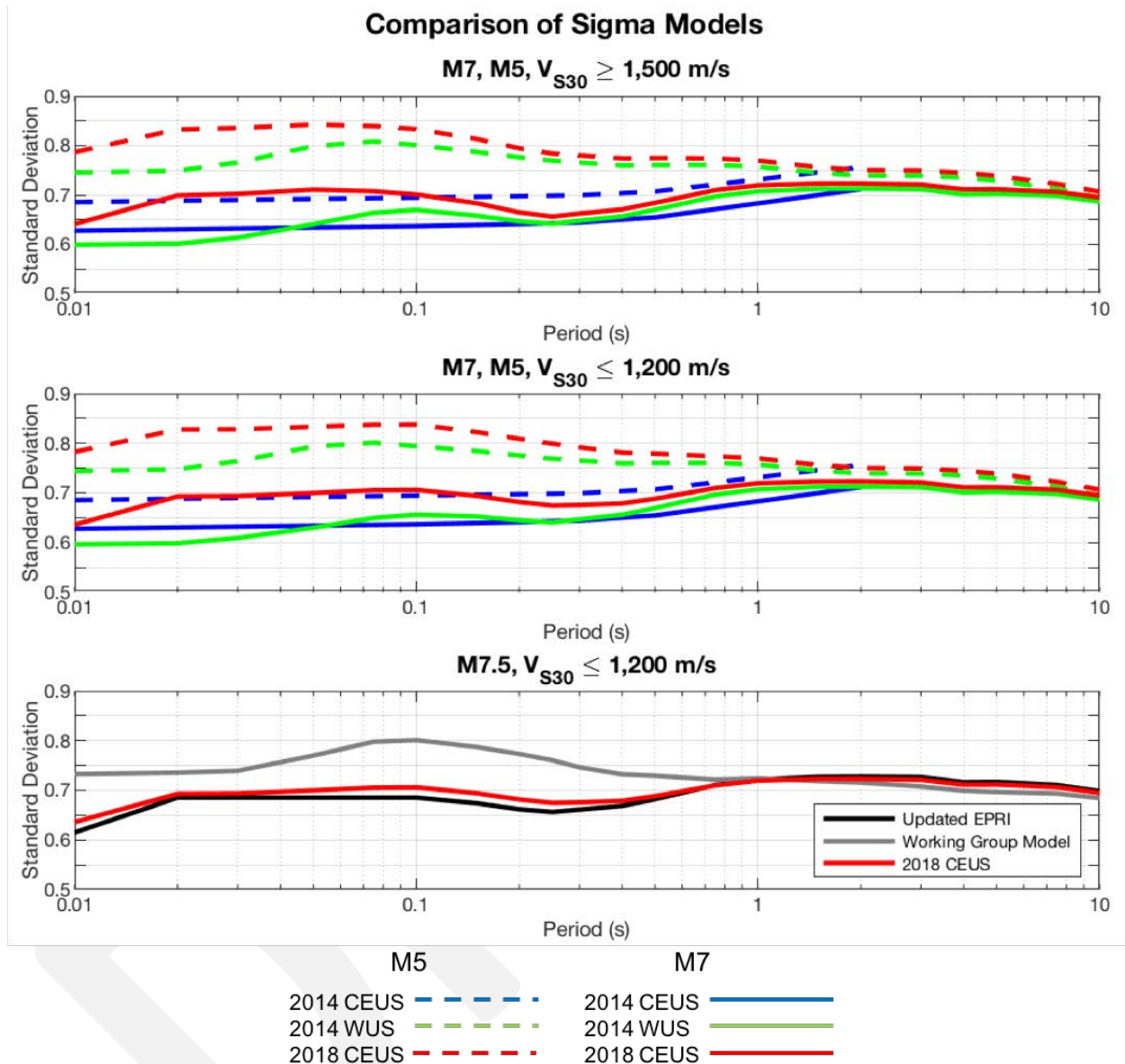
Figure 8. Comparison of sigma models for the central and eastern U.S. and western U.S. (A) V_{S30} = ≥ 1,500 m/s, and (B) V_{S30} ≤ 1,200 m/s. The 2014 NSHM CEUS sigma model is shown in blue. The 2014 NSHM WUS sigma model is shown in green. The 2018 NSHM CEUS sigma model is shown in red. Dashed lines show the M=5 model and solid lines show the M=7 model. (C) Comparison of the updated EPRI, working group model, and final weighted 2018 CEUS sigma model for M=7.5, V_{S30} ≤ 1,200 m/s.
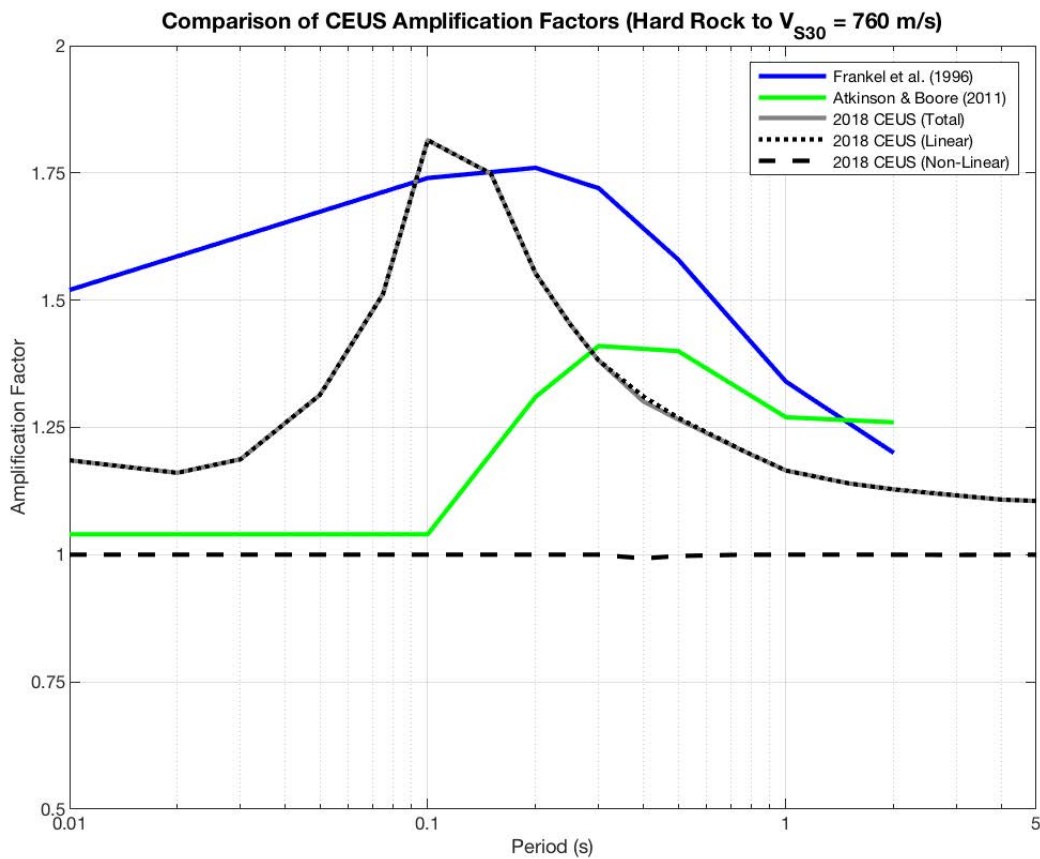
Figure 9. Comparison of central and eastern U.S. amplification factors (M7, distance = 10 km) from hard rock to V_{S30} = 760 m/s used in the 2014 NSHM and the 2018 NSHM.
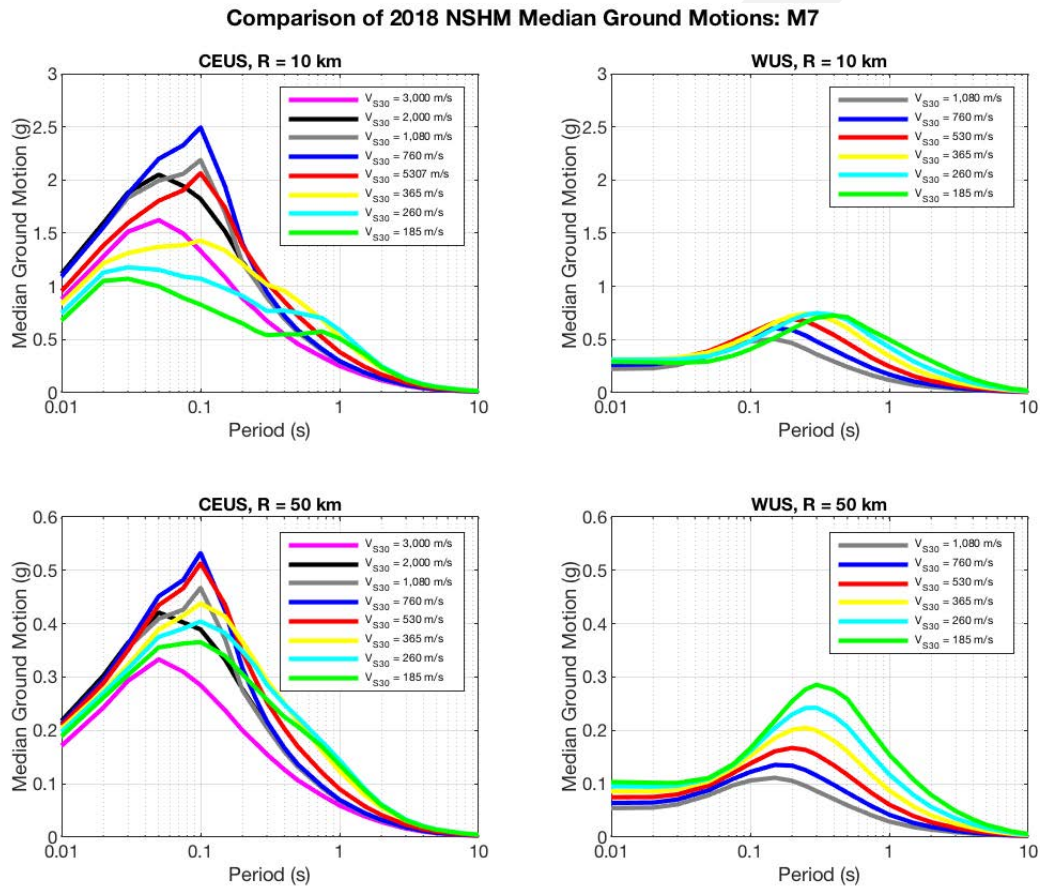
Figure 10. Ground motion vs. period plots showing a comparison of central and eastern U.S. and western U.S. median ground motions (M7) at various NEHRP site classes.

Comparison of Total Mean Hazard for the US
2018 NSHM: 2018 GMMs vs. 2014 GMMs

2% in 50 Years Probability of Exceedance, NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)

0.2 Second Spectral Acceleration (g)

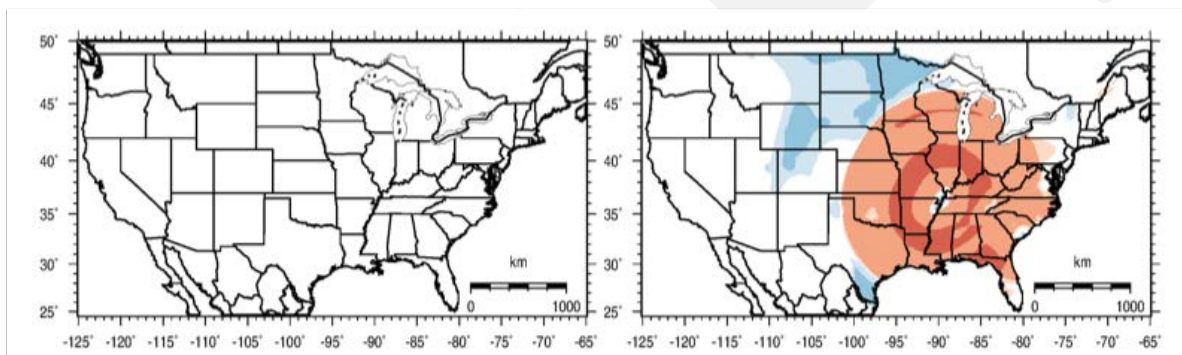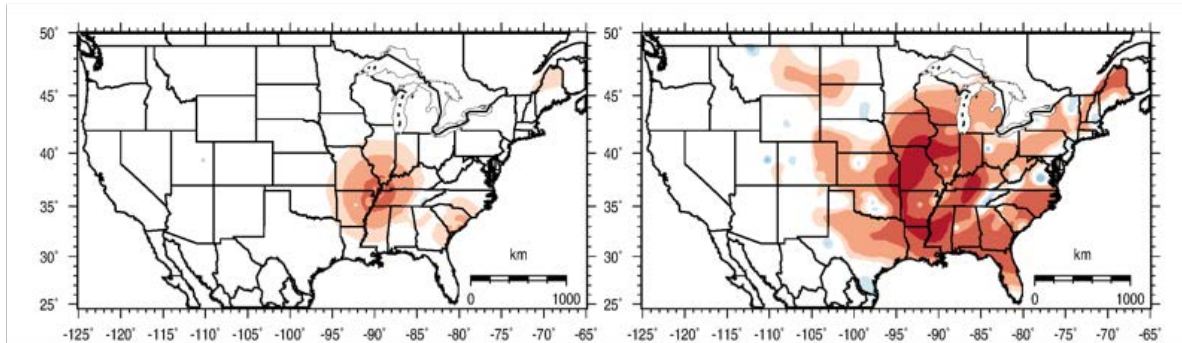1 Second Spectral Acceleration (g)

Difference

Ratio

Figure 11. Comparison of total mean hazard for the conterminous U.S. from the 2018 NSHM when using 2018 NSHM ground motion models vs. the 2014 NSHM ground motion models. The difference between 0.2 second total mean hazard is shown in the upper left plot. The ratio is shown in the upper right plot. The difference between 1 second total mean hazard is show in the lower left plot. The ratio is shown in the lower right plot. Plots are for 2% probability of exceedance and NEHRP site class boundary B/C (V_{S30} = 760 m/s).
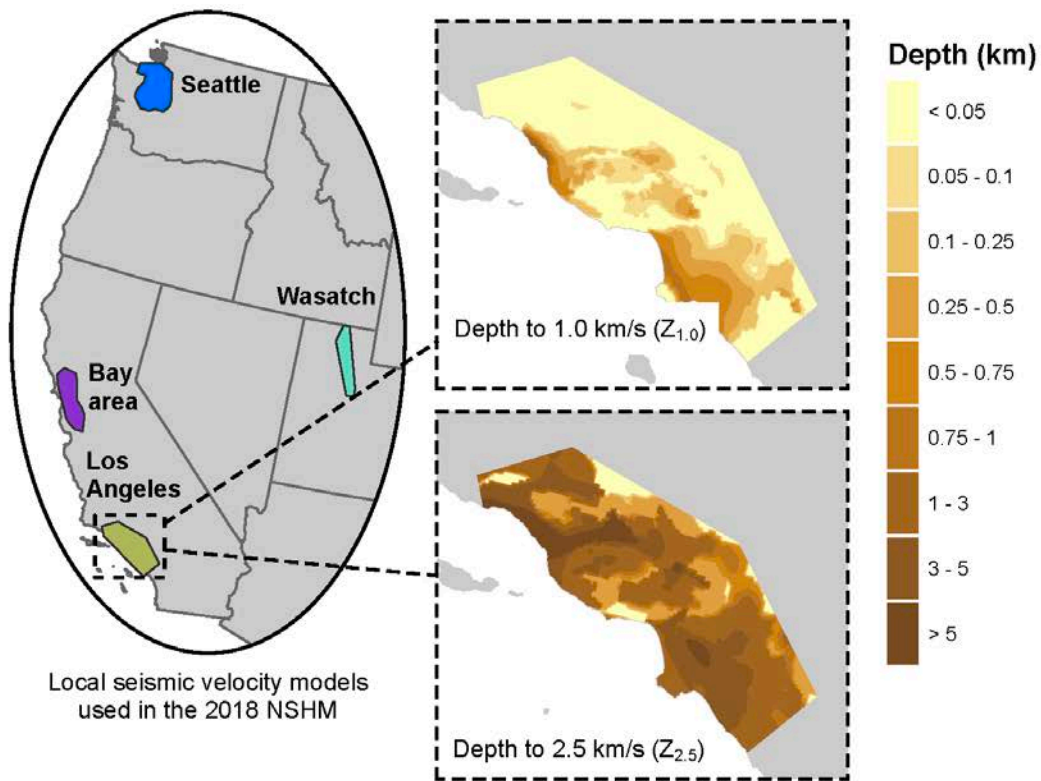
Figure 12. Map of the local seismic velocity models used in the 2018 NSHM, showing the outlines of the basin areas where ground motions are amplified when Z_x terms from the local velocity models are greater than the default terms calculated from the NGA-West2 GMMs. The local seismic velocity models used in the 2018 NSHM are Los Angeles (Lee et al., 2014), the San Francisco Bay Area (Aaggard et al., 2010), Salt Lake City (Magistrale et al., 2008), and Seattle (Stephenson, 2007).
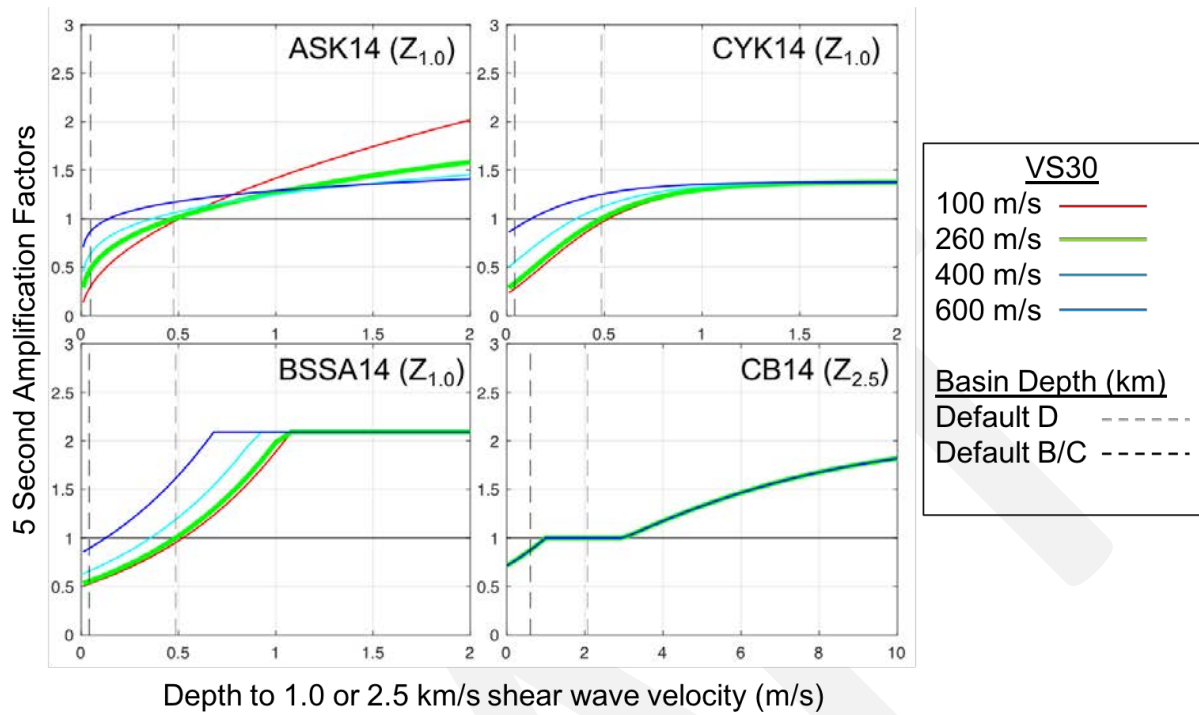
Figure 13. 5 second amplification factors for NGA-West2 ground motion models. ASK14 (Abrahamson et al., 2014), CY14 (Chiou and Youngs, 2015), and BSSA14 (Boore et al., 2015) use $Z_{1.0}$, and CB14 (Campbell and Bozorgnia, 2014) uses $Z_{2.5}$ to calculate default basin depths. Note that for the first three, if $Z_{1.0}$ is equal to the default value, the amplification factor is 1. For CB14, the amplification factor is 1 for $Z_{2.5}$ between 1 and 3 km depth.
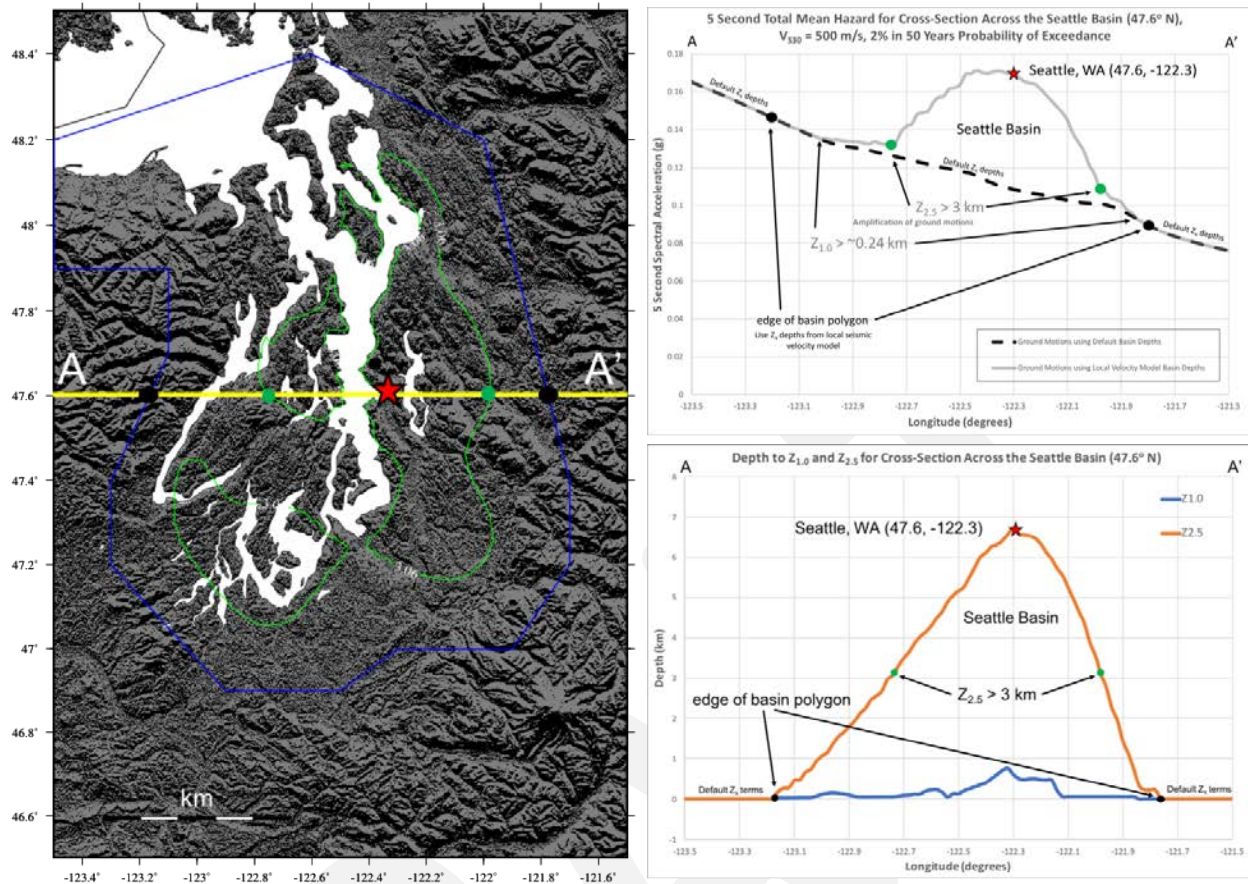
Figure 14. Example of basin amplification implemented in the 2018 NSHM in the Seattle basin. The plot on the left shows a map of the area around Seattle, WA (the location of Seattle is shown by the red star). The blue polygon shows the area in which basin depths from the local seismic velocity model (Seattle07; Stephenson, 2007) are used. The green polygon shows the area in which $Z_{2.5}$ values are greater than 3 km. The plot in the upper right shows a cross-section across the yellow line in the figure on the left and shows when default and local seismic velocity model basin terms are used. The plot in the lower right shows the values of $Z_{1.0}$ and $Z_{2.5}$ across the cross-section.
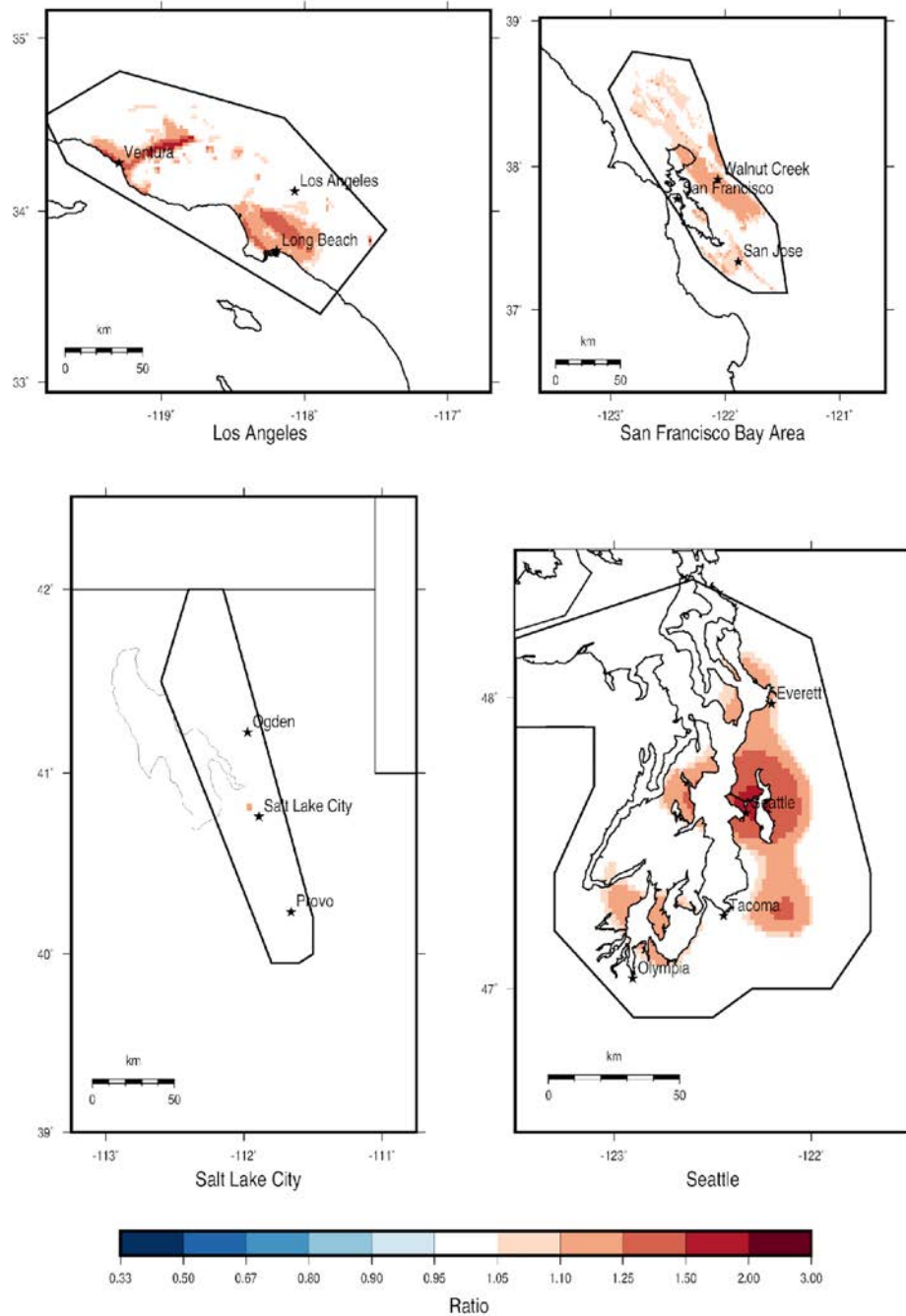
Figure 15. Ratio maps showing the difference in 5 second total mean hazard for (upper left) Los Angeles, (upper right) the San Francisco Bay Area, (lower left) Salt Lake City, and (lower right) Seattle when basin depths from the local seismic velocity models are used vs. when default basin depths calculated from the NGA-West2 ground motion models are used. The plots are for 2% in 50 years of exceedance and for NEHRP site class D (V_{S30} = 260 m/s).

2018 NSHM, 2% in 50 Years Probability of Exceedance, NEHRP Site Class Boundary B/C (V_{S30} = 760 m/s)
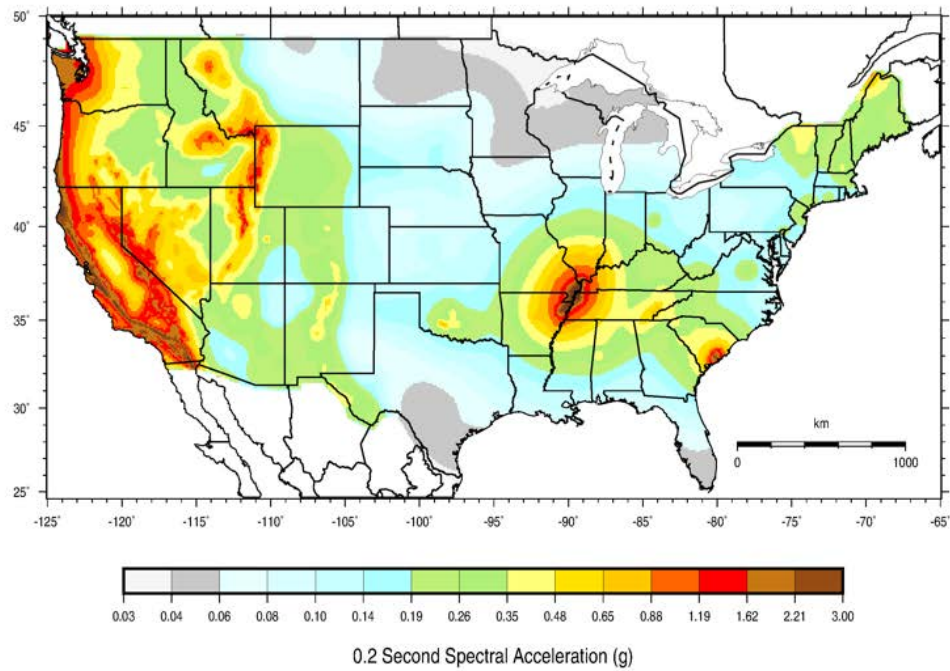
0.03 0.04 0.06 0.08 0.10 0.14 0.19 0.26 0.35 0.48 0.65 0.88 1.19 1.62 2.21 3.00

0.2 Second Spectral Acceleration (g)

2018 NSHM, 2% in 50 Years Probability of Exceedance, NEHRP Site Class D (V_{S30} = 260 m/s)

0.005 0.010 0.020 0.030 0.040 0.050 0.070 0.100 0.140 0.200 0.250 0.300 0.350 0.450 0.550 0.650
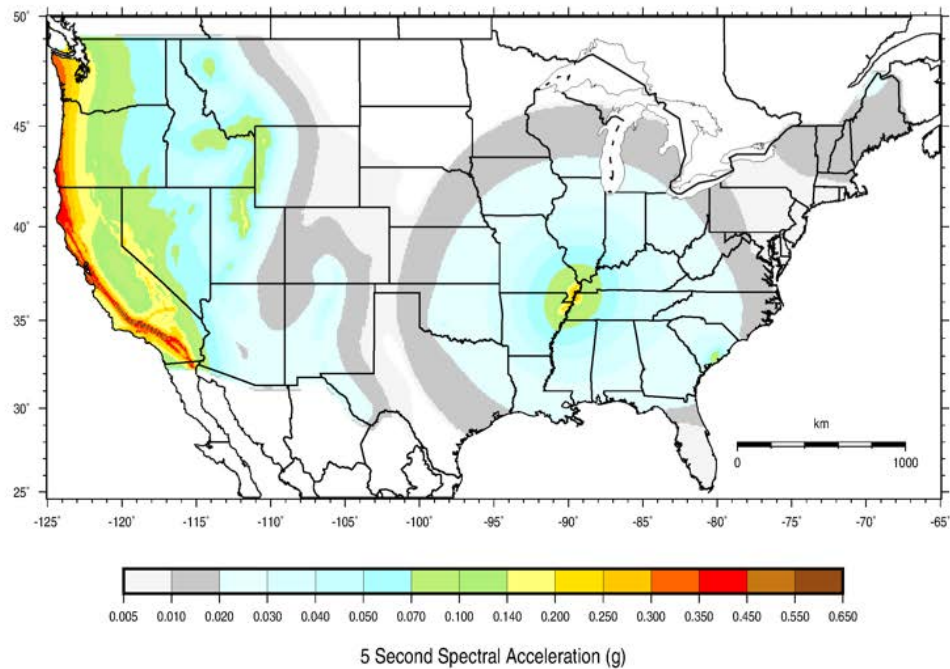
5 Second Spectral Acceleration (g)

Figure 16. Total mean hazard maps for a 2% probability of exceedance in 50 years calculated for the 2018 NSHM at: (A) 0.2 second spectral acceleration, NEHRP site class boundary B/C (V_{S30} = 760 m/s); and (B) 5 second spectral acceleration, NEHRP site class D (V_{S30} = 260 m/s), for the conterminous U.S.
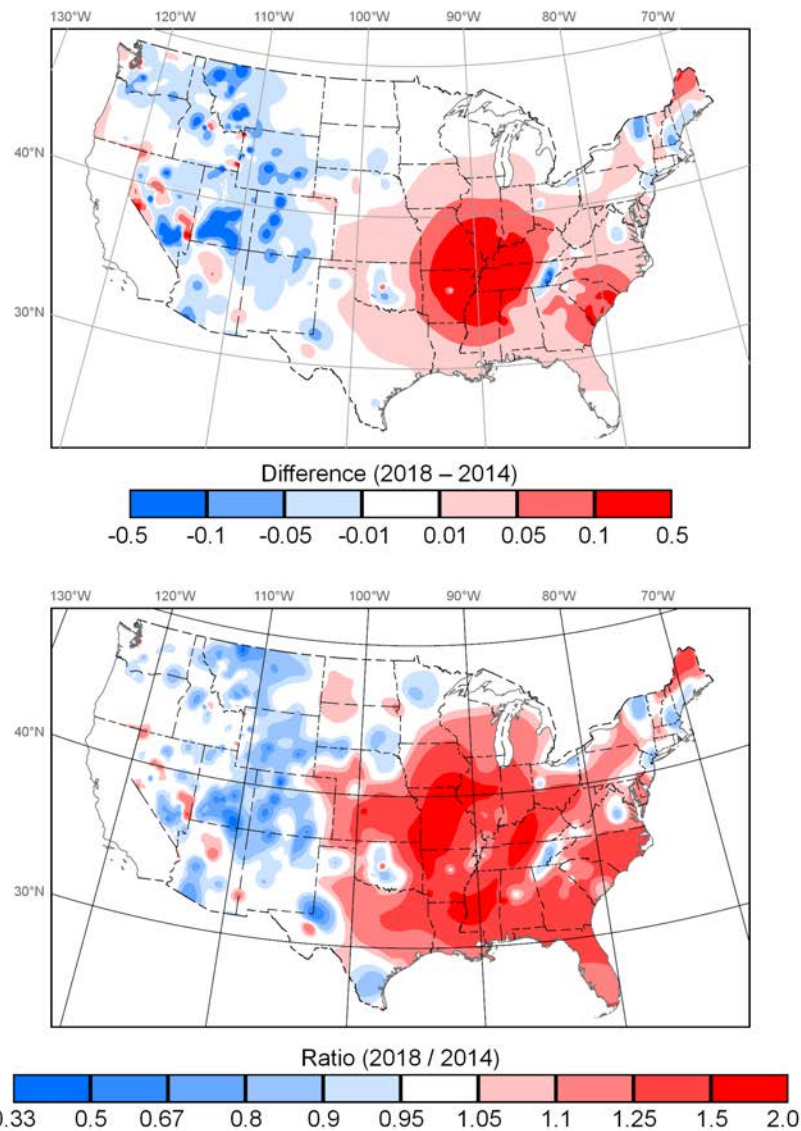
Figure 17. (A) Difference and (B) ratio maps showing comparisons between total mean hazard from the 2018 NSHM and the 2014 NSHM for the conterminous U.S. Maps are for 0.2 second spectral acceleration, 2% in 50 year probability of exceedance, and NEHRP site class boundary B/C (V_{S30} = 760 m/s).
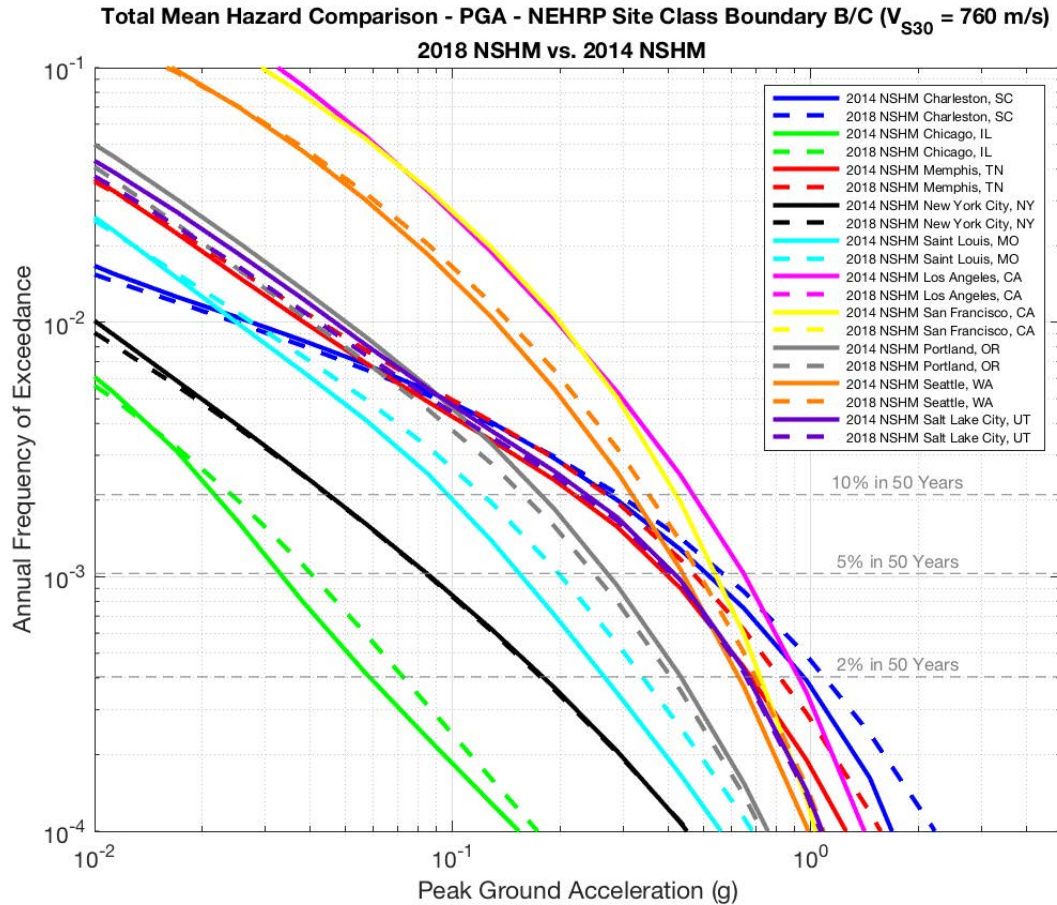
Figure 18A. Comparison of hazard curves for 10 NEHRP sites across the U.S. are shown for the 2014 NSHM (solid lines) vs. the 2018 NSHM (dashed lines). Hazard curves are plotted for peak ground acceleration and NEHRP site class boundary B/C (V_{S30} = 760 m/s).
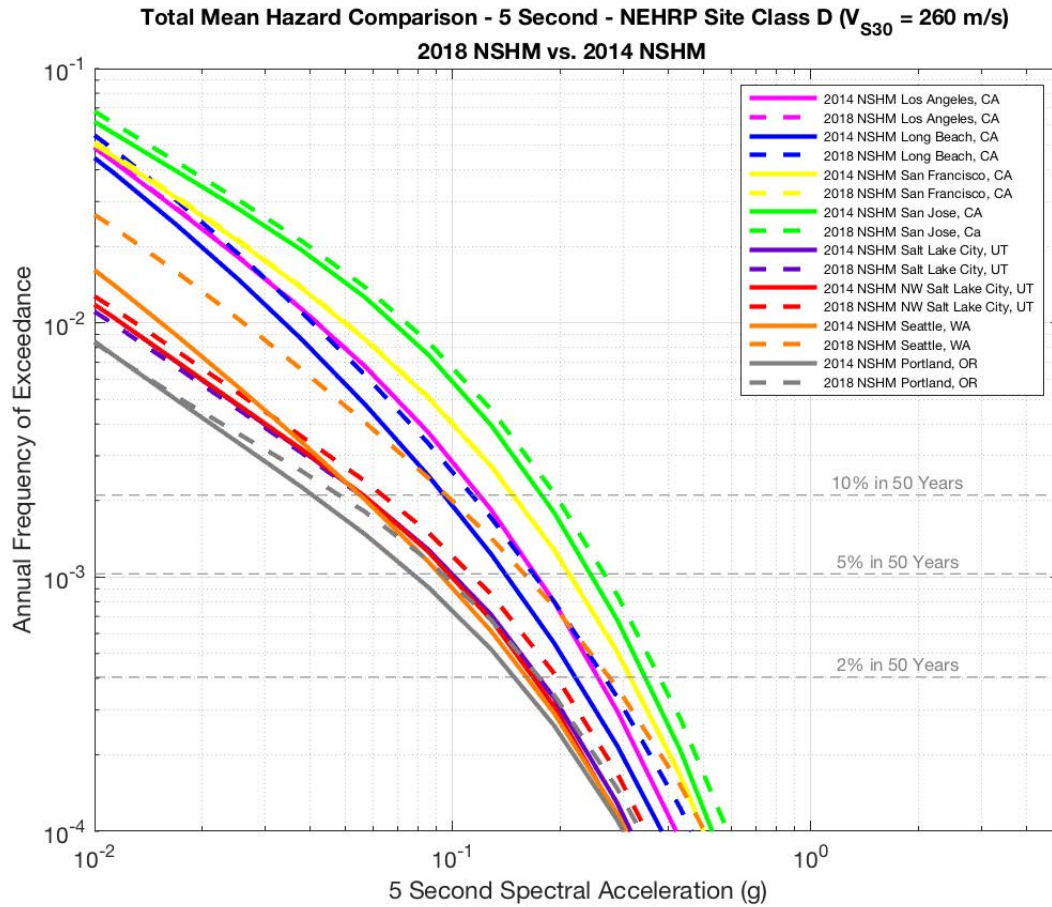
Figure 18B. Comparison of hazard curves for eight WUS sites are shown for the 2014 NSHM (solid lines) vs. the 2018 NSHM (dashed lines). Hazard curves are plotted for 5 second spectral acceleration and NEHRP site class D (V_{S30} = 260 m/s).
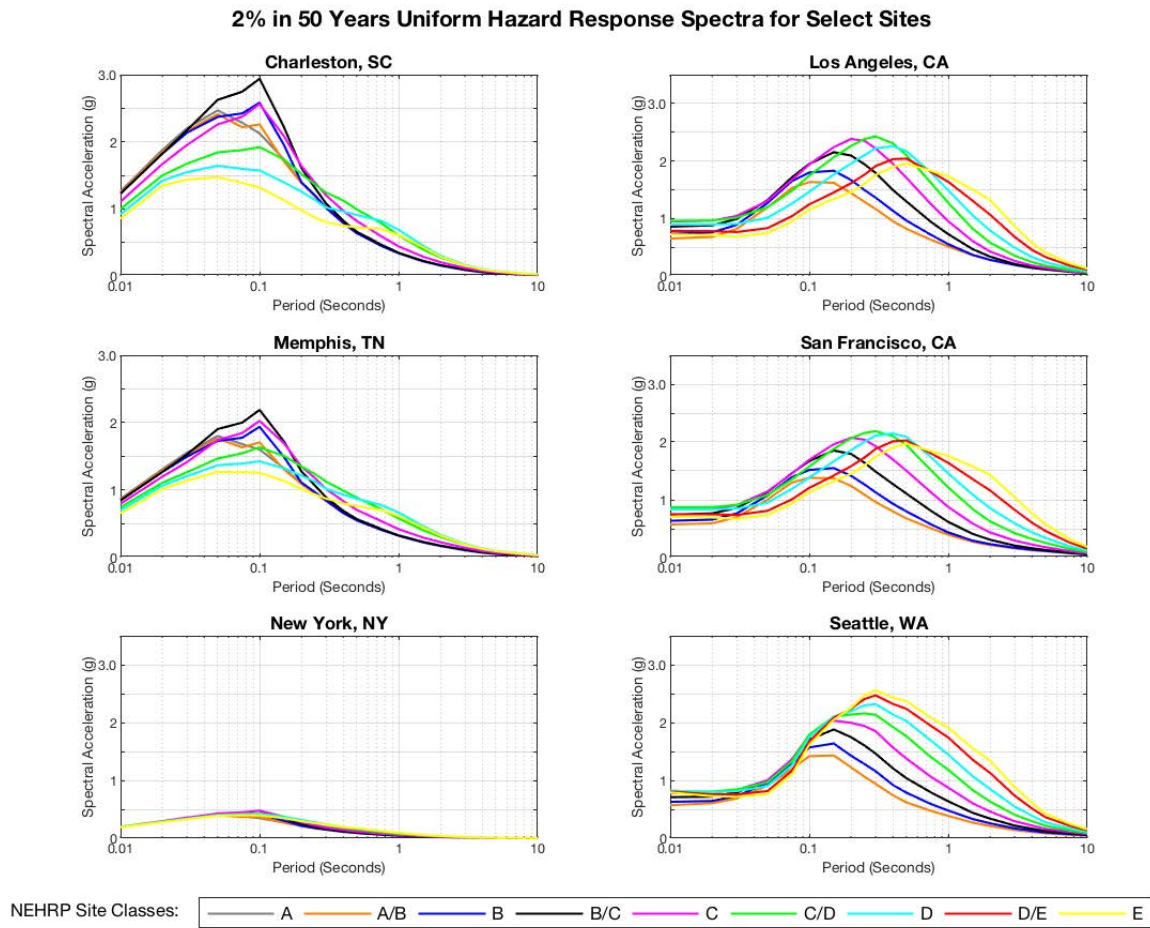
Figure 19. Uniform hazard response spectra are plotted for six NEHRP site classes across the U.S. for a 2% probability of exceedance in 50 years. CEUS and WUS sites are calculated for NEHRP site classes B (V_{S30} = 1,080 m/s), C (V_{S30} = 530 m/s), D (V_{S30} = 260 m/s), and E (V_{S30} = 150 m/s) and site class boundaries A/B (V_{S30} = 1,500 m/s), B/C (V_{S30} = 760 m/s), C/D (V_{S30} = 365 m/s), and D/E (V_{S30} = 260 m/s). Only CEUS sites (shown on the left side of the figure) are also calculated for NEHRP site class A (V_{S30} = 2,000 m/s).
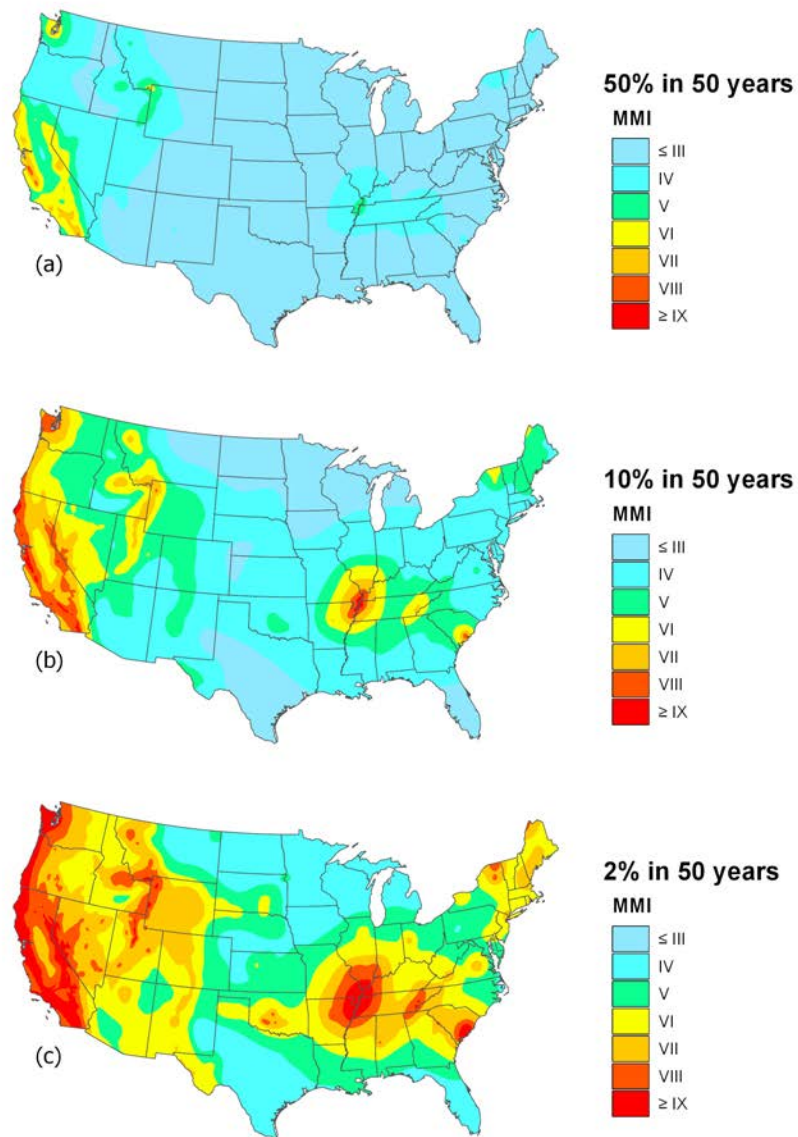
Figure 20. The 2018 Modified Mercalli Intensity (MMI) hazard map of conterminous U.S. (lower 48 states) showing estimate of earthquake shaking in terms of for (a) 50% probability of exceedance (PE) in 50 years (likely), (b) 10% PE in 50 years (infrequent), and (c) 2% PE in 50 years (rare).